

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**  
(PCT Article 36 and Rule 70)

REC'D 22 JUL 2004

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Applicant's or agent's file reference <b>P12649MA</b>	<b>FOR FURTHER ACTION</b> <small>See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)</small>	
International application No. <b>PCT/EP 03/03977</b>	International filing date (day/month/year) <b>16.04.2003</b>	Priority date (day/month/year) <b>25.04.2002</b>
International Patent Classification (IPC) or both national classification and IPC <b>H04M19/04</b>		
Applicant <b>SONY ERICSSON MOBILE COMMUNICATIONS AB et al</b>		

1. This International preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

- I  Basis of the opinion
- II  Priority
- III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV  Lack of unity of invention
- V  Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI  Certain documents cited
- VII  Certain defects in the international application
- VIII  Certain observations on the international application

Date of submission of the demand <b>03.11.2003</b>	Date of completion of this report <b>21.07.2004</b>
Name and mailing address of the International preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  <b>Domínguez, I</b> Telephone No. +49 89 2399-2232



**INTERNATIONAL PRELIMINARY  
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International application No. PCT/EP 03/03977

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

1-3 as originally filed

**Claims, Numbers**

1-14 received on 22.05.2004 with letter of 19.05.2004

**Drawings, Sheets**

1/1 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:
- the drawings, sheets:

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5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	2-11,13,14
	No: Claims	1,12
Inventive step (IS)	Yes: Claims	
	No: Claims	1-14
Industrial applicability (IA)	Yes: Claims	1-14
	No: Claims	

2. Citations and explanations

**see separate sheet**

Concerning Section V

1. The following documents (D) are referred to in this written International Preliminary Examination Report:

D1: US-A-6 023 513 (CASE ELIOT M) 8 February 2000 (2000-02-08)  
D2: PATENT ABSTRACTS OF JAPAN vol. 1997, no. 06, 30 June 1997 (1997-06-30)  
    & JP 09 055634 A (YAMAHA CORP), 25 February 1997 (1997-02-25)  
D3: EP-A-0 994 464 (KONINKL PHILIPS ELECTRONICS NV) 19 April 2000 (2000-04-19)  
D4: EP-A-1 161 076 (KONINKL PHILIPS ELECTRONICS NV) 5 December 2001 (2001-12-05)

2.1. Document D1 discloses (see in particular the passages cited in the International Search Report), according to the main features of claim 1, a device for increasing the perceived bandwidth in an audio signal path with limited bandwidth (see for example the abstract), comprising:

- an input terminal for connecting an audio signal (140 in Fig. 11; see also column 5, lines 33-34),
- an output terminal (142, Fig. 11; see also column 5, lines 34-35), and
- a splitter adapted to divide the audio path from the input terminal into two branches (cf. column 5, lines 35 to 38), a first branch (path 146) for passing a first part of the audio signal (see Fig. 11), and a second branch (second path 148) for processing a second part of the audio signal, the second branch comprising means for producing harmonics of the audio signal (see Fig. 11 and column 5, lines 38 to 42); and
- a combiner (154, see Fig. 11) for adding the harmonics produced in the second branch to the first part of the signal in the first branch at the output terminal (see also column 5, lines 42-43),
- wherein the means for producing harmonics comprises a harmonic generator (152, Fig. 11; see also column 5, lines 40 to 42).

Therefore, the device of claim 1 merely differs from that disclosed in D1 in that in the device of claim 1 it is specified that the output terminal is for connecting a speaker unit for generating an acoustic signal and in that the harmonics produced in claim 1 are out-of-band harmonics, whereas the device which is the object of D1 does not explicitly disclose these possibilities.

It is considered that the first difference is a minor implementing detail which is, if not

explicitly disclosed, clearly suggested and derivable from D1, which insists upon the fact that the device may be utilized at any point in the transmission path (cf. column 1, lines 55 to 58), i.e. also at the very output, just before applying the signal to the speaker, and which also explicitly mentions the suitability of the system disclosed therein for telephony applications and as hearing aids (see the abstract).

Moreover, in the discussion of the prior art (cf. column 1, lines 29 to 41), D1 acknowledges the existence of devices adding harmonics which are outside of the typical 4 KHz bandwidth in order to improve clarity of the signal, and points out that such an approach requires the processing to be performed at the receiver. This is, however, not a problem if, as discussed in the previous passage, the device is going to be implemented to be directly connected to the loudspeaker at the receiving end.

Hence, the person skilled in the art, starting from a device such as that known from D1 and simply trying to implement it, would apply his common sense and general knowledge and would find it obvious to connect the output 142 of the device disclosed in Fig. 11 to a speaker unit and to add out-of-band harmonics in order to further improve the clarity of the received signal, as is known from the prior art, thus arriving, without the need to exercise any inventive activity, at a device which would fall within the terms of the subject-matter of claim 1.

Therefore, the subject-matter of claim 1 does not involve an inventive step, contrary to Article 33(3) PCT.

2.2. The same applies if document D2, which discloses all the features of claim 1 except for the speaker unit, is considered as the starting point. It is to be noted that D2 does disclose adding out-of-band harmonics, since the band pass filter 4 has, for example, a frequency range of 20 KHz to 100 KHz (see paragraph 11 of attached computer-generated translation).

Hence, the subject-matter of claim 1 does not involve an inventive step, contrary to Article 33(3) PCT, in the light of the disclosure of D2, taken in combination with the general knowledge of the person skilled in the art.

2.3. Furthermore, document D3, cited in the ISR, discloses a device for increasing the perceived bandwidth in an audio signal path with limited bandwidth, comprising all the features of claim 1 (see abstract, Fig. 1 and column 3, line 42 to column 4, line 2; see also column 3, lines 22 to 25), and is thus prejudicial to the novelty of claim 1, contrary

to Article 33(2) PCT.

3. The additional features set out in the dependent claims 2 to 11 do not seem to add anything of inventive significance to the claims to which they are appended, taking into account the disclosure of the above cited documents D1 to D4, as well as the general knowledge in the art.

Indeed, D1, for example, already discloses the means for producing harmonics comprising a filter (150 in Fig. 11) and an adjustable amplifier (e.g. 108 in Fig. 9, see also column 5, lines 14 to 17), as recited in claim 2. In addition, the filter (high-pass filter 150) disclosed in D1 is arranged to separate the upper portion of the pass band as an input to the harmonic generator (cf. column 5, lines 38 to 42), as in claim 3.

The fact that the harmonic generator comprises a nonlinear circuit, as recited in claim 4, is a generally known feature and is disclosed in any one of documents D1 to D3.

Producing the harmonics by means of a digital signal processor, as in claim 5, is one of the many alternatives immediately available to the person skilled in the art.

Adding second harmonics and even harmonics, as in claims 6 and 7, is disclosed in document D1 (see e.g. Fig. 2 and column 3, lines 40 to 42).

The fact that the audio signal is a ring signal, as in claim 8, or a polyphonic ring signal, as in claim 9, is disclosed in D4 (cf. paragraphs 5, 11 and 26).

The feature of claim 10 that the audio signal is a speech signal is disclosed in documents D1 and D3.

Providing a delay or a phase shift in the first branch, as in claim 11, in order to synchronise the signals at both branches before combining them (since the processing in the second branch might take some non-negligible time) is considered to be an implementation detail which would be readily apparent to a person skilled in the art.

Therefore, the dependent claims 2 to 11, either alone or in combination, cannot be considered to offer a basis for an inventive main claim.

4. With regard to independent claim 12, which is directed to a communication apparatus characterised by including a device according to any one of claims 1 to 8, 10 and 11,

the arguments set out above under points 2 and 3 apply equally.

Therefore, the subject-matter of claim 12 does not involve an inventive step, Article 33(3) PCT, in the light of documents D1 or D2, taken in combination with the general knowledge of the person skilled in the art, and furthermore it is not novel over document D3.

5. For the reasons set out above (cf. points 2 and 3), independent claim 13, directed to a communication apparatus including a device according to claim 9, does not involve an inventive step (Article 33(3) PCT).
6. Finally, the features of claim 14, dependent on claims 12 or 13, that the communication apparatus is a portable telephone, a pager, a communicator or an electronic organiser, are known, for example, from D3 (cf. column 3, lines 4 to 12) or D4 (see Fig. 1).

**Further remarks**

1. Both independent claims 12 and 13 are directed to a communication apparatus including a device for increasing the perceived bandwidth, respectively according to "any one of claims 1 to 8, 10 and 11" and to "claim 9".

It is to be noted that, since claim 9 is dependent on claim 8, which is dependent on any one of claims 1 to 7, it is also indirectly dependent on claims 1 to 7. Moreover, since claim 11 is dependent on any one of claims 1 to 10, it is also dependent on claim 9.

Thus, they effectively relate to the same subject-matter, and therefore, their subject-matters are of overlapping scope. Hence, claims 12 and 13 do not meet the requirements of Article 6 PCT regarding conciseness of the claims.

2. The applicant's attention is drawn to the fact that the use of the expression "such as" (claim 10) has no limiting effect on the scope of a claim, and therefore, the features to which such expression refers are regarded as entirely optional (see PG-III, 4.6.)
- 3.1. The statement of the invention on pages 1 and 2 should have been brought into agreement with the wording of the claim(s) of broadest scope as finally amended.
- 3.2. In order to meet the requirements of Rule 5.1.(a),(ii) PCT, the relevant prior art, i.e. the documents D1 to D4 noted above, should have been acknowledged by reference and

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briefly discussed in the introductory part of the description.

## CLAIMS

1. Device for increasing the perceived bandwidth in an audio signal path with limited bandwidth, comprising: an input terminal (1) for connecting an audio signal, an output terminal (2) for connecting a speaker unit for generating an acoustic signal, and a splitter (3) adapted to divide the audio path from the input terminal (1) into two branches, a first branch (4) for passing a first part of the audio signal, and a second branch (5) for processing a second part of the audio signal, the second branch comprising means (7, 8, 9) for producing harmonics of the audio signal; and a combiner (6) for adding the harmonics produced in the second branch (5) to the first part of the signal in the first branch (4) at the output terminal (2), characterised in that the means for producing harmonics comprises a harmonic generator (8) for producing out-of-band harmonics.
2. Device according to claim 1, characterised in that the means for producing harmonics further comprises a filter (7), and an adjustable amplifier (9).
3. Device according to claim 2, characterised in that the filter (7) is arranged to separate the upper portion of the pass band as an input to the harmonic generator (8).
4. Device according to claim 1, 2 or 3, characterised in that the harmonic generator (8) comprises a nonlinear circuit.
5. Device according to claim 1, 2 or 3, characterised in that the harmonic generator (8) comprises a digital signal processor ,DSP.
6. Device according to any one of claims 1 to 5, characterised in that the means for producing harmonics is arranged to add second harmonics.
7. Device according to any one of claims 1 to 5, characterised in that the means for producing harmonics is arranged to add even harmonics.
8. Device according to any one of claims 1 to 7, characterised in that the audio signal is a ring signal.
9. Device according to claim 8, characterised in that the audio signal is a polyphonic ring signal.
10. Device according to any one of claims 1 to 7, characterised in that the audio

signal is a speech signal, such as GSM or Bluetooth™ audio.

11. Device according to any one of claims 1 to 10, characterised in that the first branch (4) is provided with means (10) for providing a delay or a phase shift.  
5
12. Communication apparatus, characterised by including a device for increasing the perceived bandwidth according to any one of claims 1 to 8, 10 and 11.
13. Communication apparatus, characterised by including a device for increasing the perceived bandwidth according to claim 9, comprising a polyphonic sound effect generator for producing the polyphonic ring signal.  
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14. Communication apparatus according to claims 12 or 13, characterised in that the communication apparatus is a portable telephone, a pager, a communicator or an electronic organiser.  
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JAPANESE [JP,09-055634,A]

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AIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION  
TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

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ranslation done.]

## NOTICES \*

Japan Patent Office is not responsible for any images caused by the use of this translation.

This document has been translated by computer. So the translation may not reflect the original precisely. \*\*\*\* shows the word which can not be translated. In the drawings, any words are not translated.

## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[001]

[Field of the Invention] This invention relates to a higher-harmonic addition circuit suitable as the analog playback section of digital audio devices, such as CD and DAT.

[002]

[Description of the Prior Art] As everyone knows, the spectrum of the music signal to deal with is restricted to less than 1/2 of a sampling frequency  $f_s$  on the need of preventing generating of a clinch noise in a digital audio, since [ therefore, / of CD ] the sampling frequency  $f_s$  at the time of record is 44.1kHz at a case -- record -- an object -- the spectrum of a band 22.05kHz or more is beforehand removed from a music signal (analog signal), and the digital storage to the A/D conversion and CD of a music signal with which this high region clearance was made is performed. Since the upper limit of a \*\*\*\*\* frequency is set to 20kHz within a human being's lug, if it can transmit to 22.05kHz, it will be a reason for having set the sampling frequency of CD to 44.1kHz that it is satisfactory.

[003]

[Problem(s) to be Solved by the Invention] However, the spectrum of a music signal exists in 20kHz or more actually. And recently, the opinion whether the existence of the spectrum 20kHz or more which should not have this \*\*\*\*\* has affected the psychology of those who listen to music is coming out. Moreover, what removed the spectrum 20kHz or more of a music signal, and the thing which is not removed are made to hear it and an electroencephalogram is investigated, although not removed, there is also a report that the direction has much generating of an alpha wave. Moreover, even if it hears the record which performs record and playback with an analog signal although it will get tired if CD which performs record and playback with a digital signal is heard for a long time while a sound is clear for a long time, fairly many people are not getting tired, and falling and attaching are in it, and as for this cause, CD also has the opinion that a signal 20kHz or more is because SUPPORI has become that there is nothing.

[004]

[The product which adds and outputs the noise which has a spectrum 20kHz or more to the sound reproduced from CD is coming out from such a background. However, since it does not become carrying out the higher harmonic removed on the occasion of digital storage as before even if it adds a noise unrelated to such an original sound to a playback sound, there is a limitation also in taking out naturalness.]

[005]

[This invention is made in view of the situation explained above, the spectrum of a high region lost from the audio signal on the occasion of transmission or record is returned as much as possible, and it aims at offering the higher-harmonic addition circuit which can reproduce the audio signal which was rich in the natural feeling.]

[006]

[Means for Solving the Problem] Invention concerning claim 1 has nonlinear transfer characteristics, and makes a summary the higher-harmonic-wave addition circuit characterized by providing the band pass filter which chooses and outputs the signal of the predetermined frequency band by the side of a high region rather than the frequency band of said audio signal from the output signal of the nonlinear circuit which adds and outputs a higher harmonic wave to an audio signal, and said nonlinear circuit, and the circuit adding said audio signal and output signal of said band pass filter.

[007]

[Invention concerning claim 2 makes a summary the higher-harmonic addition circuit characterized by providing the band pass filter which chooses and outputs the signal of the predetermined frequency and by the side of a high region rather than the frequency band of said audio signal from the output signal of the pitch control circuit which compresses an audio signal into time amount shaft orientations, and outputs the signal of the frequency of the integral multiple of the original frequency, and said pitch control circuit, and the circuit adding said audio signal and output signal of said band pass filter.]

)08]

mbodiment of the Invention] Hereafter, the gestalt of operation is explained in order to make this invention further easy to understand. The gestalt of this operation cannot show one mode of this invention, and can change it into arbitration in the range of this invention.

)09] A. The 1st operation gestalt drawing 1 is the block diagram showing the configuration of the higher-harmonic-wave addition circuit which is the 1st operation gestalt of this invention. This operation gestalt applies this invention to the part of the last stage slack analog circuit of a digital audio device, and they are DAC (digital to analog converter) from which one changes into an analog signal the digital signal produced from the sources, such as CD, and the low pass filter which 2 removes the spectrum of a high region of the output signal of DAC1, and outputs a smooth analog signal among drawing.

)10] 3 is a nonlinear circuit which has nonlinear transfer characteristics. As this nonlinear circuit, the circuit shown, for example in drawing 2 or drawing 4 can be used. The nonlinear circuit shown in drawing 3 is a detector circuit, and as shown in drawing 3, it outputs only a polar fixed signal among input signals. Moreover, the nonlinear circuit shown in drawing 4 is a clipping circuit, as shown in drawing 5, it is inputted as it is about the signal in an input signal and below fixed level, and it is stopped and outputted to a fixed level about the part exceeding fixed level.

)11] In drawing 1, 4 is a band pass filter for choosing the spectrum of a high region from an audible frequency range among the output signals of a nonlinear circuit 3, for example, has the 20kHz - 100kHz passband or the 20kHz - 150kHz passband. 5 is an adder which adds the output signal of a band pass filter 4 and the output signal of a low pass filter 2, and is supplied to a loudspeaker (graphic display abbreviation).

)12] According to the above configuration, the music signal (analog signal) outputted through DAC1 and the low pass filter 2 is inputted into a nonlinear circuit 3, turns into a signal including the higher harmonic of the frequency of the integral multiple of a music signal besides an original music signal, and is outputted from a nonlinear circuit 3. The spectrum by the side of a high region is chosen from an audible frequency range with a band pass filter 4 among the output signals of this nonlinear circuit 3, and it is added to the original music signal by the adder 5, and is outputted.

)13] The spectrum added to the music signal of the origin of this has the frequency of the integral multiple of the music signal outputted from a low pass filter 2, and is considered to be what is more equivalent to the higher harmonic by the side of a high region than the spectrum removed in advance of digital storage, i.e., the audible frequency range included in the original music signal. Therefore, according to this higher-harmonic-wave addition circuit, the analog signal near the original music signal in front of digital storage is outputted from an adder 5.

)14] B. Although the higher harmonic wave over a music signal was added by the analog circuit with the operation gestalt of the 2nd operation gestalt above 1st, a digital circuit performs this processing with this 3rd operation gestalt.

)15] In performing D/A conversion in a digital audio, in order to simplify the design of the analog low pass filter for low-pass filtration of the analog signal after D/A conversion, it is common to insert a digital filter with exaggerated sampling function in the preceding paragraph of DAC.

)16] This operation gestalt is established between this DAC and a digital filter, and has the configuration shown in drawing 6. In this drawing, 1 is DAC and 6 is the above-mentioned digital filter. And 7 is a nonlinear circuit which has nonlinear transfer characteristics, and adds and outputs a higher harmonic to the digital music signal outputted from a digital filter 6. 8 is a band pass filter for choosing the spectrum of a high region from an audible frequency range among the output signals of a nonlinear circuit 7. And 9 is an adder which adds the output signal of a band pass filter 8, and the output signal of a digital filter 6, and is applied to DAC1.

)17] As for the digital music signal reproduced from CD etc., according to the above configuration, the exaggerated sampling of the sampling frequency is increased by the digital filter 6 4 times or 8 times. Therefore, even if the sampling frequency  $f_s$  of the digital music signal reproduced from CD etc. is 44.1kHz in order that DAC1 the very thing may operate by one 4 times or 8 times the sampling frequency of this, even if it generates a higher harmonic 20kHz or more with a nonlinear circuit 7 and a band pass filter 8, a problem is not produced at all.

)18] C. The 3rd operation gestalt drawing 7 is the block diagram showing the configuration of the higher-harmonic-wave addition circuit which is the 3rd operation gestalt of this invention. This higher-harmonic-addition circuit forms the adder 13 adding the pitch control circuits 10-12 and these output signals instead of the nonlinear circuit 7 in the operation gestalt ( drawing 6 ) of the above 2nd. Here, the pitch control circuits 10-12 compress into time amount shaft orientations the digital music signal which a digital filter 6

puts using a ring buffer, and output it respectively as a wave-like digital signal of one the twice of the signal frequency, 3 times, and 4 times the frequency of this. The output signal of each pitch control circuit given to a band pass filter 8 through an adder 13. About other actuation, it is the same as that of the operation gestalt of the above 2nd. Also in this operation gestalt, the same effectiveness as the operation gestalt of the above 2nd is acquired.

[19] D. In addition, although the various operation gestalten of this invention were explained above, the applicability of this invention is not restricted to the field of a digital audio, and may be realized in the transmission system which transmits a sound signal like a telephone using a narrow band with the gestalt adding the higher harmonic removed in advance of transmission in a receiving side. moreover, as having realized this invention also in each above-mentioned operation gestalt -- digital one and an analog -- it is applicable to any transmission system.

[20] [Effect of the Invention] Since a higher harmonic wave is generated and it was made to add from the produced audio signal according to this invention as explained above, it will add to the audio signal after producing the thing near the higher-harmonic-wave signal removed from the original audio signal on the occasions, such as digital storage, and is effective in the audio signal which was rich in the natural feeling and reproducible.

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VIII-3-1	<p><b>Declaration: Entitlement to claim priority</b></p> <p>Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application specified below, where the applicant is not the applicant who filed the earlier application or where the applicant's name has changed since the filing of the earlier application (Rules 4.17(iii) and 51bis.1(a)(iii)):</p> <p>Name:</p>	<p><b>in relation to this international application</b></p> <p><b>SONY ERICSSON MOBILE COMMUNICATIONS AB is entitled to claim priority of earlier application No. 60/378,836 by virtue of the following:</b></p>
VIII-3-1 (iv)		<p><b>an assignment from KÖRNER, Peter to SONY ERICSSON MOBILE COMMUNICATIONS AB, dated 28 May 2002 (28.05.2002)</b></p>
VIII-3-1 (ix)	<p>This declaration is made for the purposes of:</p>	<p><b>all designations</b></p>